THE USE OF BLOOD AND BLOOD PRODUCTS IN THE MATERNITY WARD OF BOITUMELO REGIONAL HOSPITAL

SERAHOME OBED MODIKO

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Public Health in the field of Hospital Management

May 2012

DECLARATION

I, Serahome Obed Modiko, declare that this research report is my own work. It is being submitted for the degree of Master Public Health in the field of Hospital Management at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or for any examination at this or any other University.

.....

18th May 2012

Johannesburg

DEDICATION

I dedicate this work to the following;

Our All Mighty God who gave me the strength, wisdom and made it possible for me to complete this study.

My wife Matsoana, for the support and encouragement she always gave me throughout this study.

My children; Itumeleng and Katleho, who understood and encouraged me to work hard and persevere, despite all the challenges that came my way.

ACKNOWLEDGEMENT

I wish to extend my heartfelt gratitude to the following people for their efforts, support, guidance and contributions that led to the successful completion of this study;

- Doctor D Basu and Dr J Kusari, my supervisor who was always supportive and willing to assist me whenever the need arose especially when I was feeling less motivated to continue with my studies due to my work environment.

- Mrs SR Noge, the Chief Executive Officer of Tokollo/Mafube District Hospital Complex who understood my situation and assisted me with data collection at Boitumelo Regional Hospital.

- The management of Boitumelo Regional Hospital for supporting the study.
- The support staff, especially admissions clerks for their assistance and patience during the data collection stage of the research.

- Professional Nurses (Midwives) Ntombi Malekele, Nokufa Nkhame and Maki Kau for their unwavering support and assistance.

- Lastly, the Free State Department of Health, my colleagues in the hospital and district as well as Wits University management for their support and the opportunity afforded me to study at this University.

ABSTRACT OF RESEARCH

BACKGROUND: Recently, South African health system has been experiencing shortage of blood and blood products due to increase in demand for conditions (such as road accident injuries, assaults, surgery and complications of labour) and decrease in supply due to conditions such as Human Immunodeficiency Virus and Hepatitis B. This resulted in difficulty in managing conditions such as obstetric haemorrhages which is one of the commonest causes of maternal mortality and morbidity in South Africa. It was therefore important to monitor the use of these products in South African hospitals to avoid inappropriate use as well as to contain expenditure. However, no formal study has been done in recent past to systematically study the use of blood and blood products in the maternity units in these hospitals. The researcher believed that this study that was conducted in the Boitumelo Regional Hospital based in the Free State would provide evidence to provincial as well as institutional managers regarding the use of blood and blood products and to quantify financial resources spent on these items. This particular Hospital was chosen because of its significant expenditure on the blood and blood products mainly for maternity patients.

AIM: To determine the extent of the use of blood and blood products in the Maternity ward of the Boitumelo Regional Hospital and the factors that influenced their uses.

METHODOLOGY: The study design was a cross-sectional study based on retrospective review of routinely collected hospital data from hospital records of patients for the period of 1 April 2009 to 31 March 2010. The setting of the study was the maternity ward of Boitumelo Regional Hospital. Data was collected on the following variables: types of blood and blood products transfused, profile of patients transfused with blood and blood products, turn-around time and cost of these products. Data from the hospital records was captured in the data collection tools designed for the study and descriptive statistics was used to report the findings.

RESULT: This is probably the first study done at a regional hospital setting in South Africa which looked at broad issues pertaining to the use of blood and blood products in the Maternity ward of the Boitumelo Regional Hospital, and the factors associated with these specified blood and blood products during one study period. The study found 99 (4.2%) among these 2304 patients delivered during this one year period received blood and blood products transfusion (13 units of whole blood, 250 units of red blood cells, 33 units of fresh frozen plasma and 1 unit of platelet). Primiparity (32, 32.6%), pre-term labour (49, 49.5%), booking status (unbooked 20, 20.4%) were found to be common among these patients. A significant number of them (36, 36.4%) were anaemic based on their booking haemoglobin but only a few of them were diagnosed and treated for anaemia. Among the other antenatal diseases, Pregnancy Induced Hypertension was commonest (27.3%) followed by Human Immunodeficiency Virus (15.2%). The majority of the subjects who received transfusion had Normal Vaginal Delivery signifying the need for active management of third stage. Only 5% (36/776) of Caesarean Section patients received transfusion, which is much lower than other studies. The median blood loss during delivery was 400 ml. Seventeen (17.5%) patients were transfused before delivery and one (1%) was transfused during delivery and 81 patients (81.5%) were transfused after delivery. Eighteen of them (18.4%) were transfused for Antepartum Haemorrhage and 81 (81.6%) of them were transfused for Postpartum Haemorrhage. The median time interval between prescription and administration was 160 min which is quite long and could be improved by reducing the interval between prescription and ordering blood and interval between receipt and administration. The total cost of transfusion during one year study period was R 329,579.27 (Whole blood: R7, 433.37, Red Blood Cell: R282, 192.50, Fresh Frozen Plasma: R33, 411.37 and Platelet: R6, 542.03) and the average cost of transfusion per patient was R3329.01.

CONCLUSION: The findings of this study will be reported to the Hospital management for improving management of obstetrics patients. The researcher also proposed further study among all the patients who received transfusion at all

the regional hospitals in the Free State Province to compare the use of blood and blood products in these institutions.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF TERMS

Antepartum Haemorrhage – is defined as bleeding from the genital tract in late pregnancy, after the 28th week of gestation and before the onset of labour (Bennett and Brown 1989)

Blood Expanders – are defined as resuscitation fluids used in acute clinical conditions associated with hypovolemia (Department of Health, 2008 - Clinical Guidelines for the use of Blood and Blood Products in South Africa).

Confidential Enquiries into Maternal Deaths – is defined as a systematic multidisciplinary anonymous investigation of all or a representative sample of maternal deaths occurring at an area, region (state) or national level which identifies the numbers, causes and avoidable or remedial factors associated with them (Pattison, Makin and Delport 1995).

Ectopic pregnancy – it is defined as a condition whereby a fertilized ovum embeds outside the uterus (Bennett and Brown 1989)

Fresh Frozen Plasma – is plasma separated from anticoagulated whole blood within 18 hours of donation and it is done by centrifuging whole blood in a closed sterile system and freezing the plasma to below -18 degree Celsius (Department of Health, 2008 - Clinical Guidelines for the use of Blood and Blood Products in South Africa).

Maternal Death Rate – refers to the number of maternal deaths in a given time period per 100 000 women of reproductive age during the same period (Beksinska, Kunene and Mullick 2004)

Maternal Mortality – it is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, from any cause related to or

aggravated by the pregnancy or its management, but not from accidental causes (The International Classification of Diseases, Injuries and Causes of Death – 10th Revision).

Maternal Mortality Ratio – it is defined as the number of women who die as a result of childbearing, during the pregnancy or within 42 days of delivery or termination of pregnancy in one year, per 100 000 live births during that year (Beksinska, Kunene and Mullick 2004).

Postpartum Haemorrhage – is defined as excessive bleeding from genital tract after delivery (Department of Health 2007. Saving Mothers - Essential Steps in the Management of Common Conditions Associated with Maternal Mortality).

Whole Blood – is defined as a complex tissue from which the numerous and clinically appropriate components are processed and it is used in massive haemorrhage with possibility of recurrence or continuation (Department of Health, 2008 - Clinical Guidelines for the use of Blood and Blood Products in South Africa).

LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Virus
ANC	Antenatal Care
APH	Antepartum Haemorrhage
BBA	Born Before Arrival
BTS	Blood Transfusion Services
CCF	Congestive Cardiac Failure
CS	Caesarean section
FFP	Fresh Frozen Plasma
GA	Gestational Age
Hb	Haemoglobin
Hct	Haematocrit
HIV	Human Immunodeficiency Virus
HST	Health Systems Trust
MDG	Millennium Development Goals
MMR	Maternal Mortality Ratio
NVD	Normal Vaginal Delivery
Plt	Platelet
PPH	Postpartum Haemorrhage
RBC	Red Blood Cells
SADHS	South African Demographic and Health Survey
StatsSA	Statistics South Africa
WHO	World Health Organization

CHAPTER 1
INTRODUCTION

The purpose of this study was to determine the extent of the use of blood and blood products in the Maternity ward of a Regional Hospital and the factors that influence their uses. This introductory chapter will cover the background to the study, statement of the problem, its aims and objectives and an outline of subsequent chapters.

1.1 BACKGROUND

Transfusion of blood and blood products is a requirement to save patients lives thus the need for the hospital to ensure availability of these items at all times. They form an integral and essential part in the management of obstetric patients. Blood transfusions involve a number of factors including availability, the indications for transfusion, the process itself, as well as the complications that may arise from the transfusion (Basu, Hartford, Nzama, et al, 2012).

Hospitals in the public sector have a dedicated budget for blood and blood products. Clinicians are expected to follow blood and blood products transfusion policies and guidelines when they prescribe these products to ensure optimum use of allocated resources. Those who are charged with the responsibility of ensuring that blood and blood products are transfused to patients must ensure that these items are not wasted at all times.

1.2 JUSTIFICATION OF STUDY

Recently, South African health system has been experiencing shortage of blood and blood products due to increase in demand for conditions (such as road accident injuries, assaults, surgery and complications of labour) and decrease in supply due to conditions such as HIV and Hepatitis B. This resulted in difficulty in

managing conditions such as obstetric haemorrhages which is one of the commonest causes of maternal mortality and morbidity in South Africa. It is therefore important to monitor the use of these products in South African hospitals to avoid inappropriate use as well as to contain expenditure. However, no formal study has been done in recent past to systematically study the use of blood and blood products in the maternity units in these hospitals. The researcher believes that this study will be able to address that gap and will be able to provide evidence to institutional as well as provincial management regarding appropriate use of blood and blood products and to quantify financial resources spent for these items.

1.3 MOTIVATION FOR THE STUDY

Boitumelo Regional Hospital is a 312 bed hospital, situated in the Fezile Dabi District (previously known as the Northern Free State District) in the Free State Province. The Hospital experiences between 180 – 250 normal deliveries per month and between 65 – 74 complicated deliveries per month. Over the past few years the Hospital has been overspending on blood and blood products and the majority of the blood products are being used in the Maternity ward. Therefore, it is felt that there is a need to systematically study the use of blood and blood products in the Maternity unit to optimise their use.

1.4 RESEARCH QUESTION

What is the use of blood and blood products in the Maternity ward of the Boitumelo Regional Hospital? What factors influence their use? What is the turn-around time and what is their cost?

1.5 STUDY OBJECTIVES

1.5.1 BROAD OBJECTIVE

To describe the use of blood and blood products in the Maternity ward of the Boitumelo Regional Hospital, the factors associated with these specified blood and blood products during the study period of 1 April 2009 to 31 March 2010.

1.5.2 SPECIFIC OBJECTIVES

I. To describe the specified blood and blood products ordered in this ward during the study period.

II. To determine the number of patients who received transfusion during the study period.

III. To determine the factors (such as demographic profile, obstetric profile, transfusion, and maternal and foetal outcome) associated with utilization of these products in the maternity ward during the study period.

IV. To determine the turn-around time of these products.

V. To determine cost of these products used during the study period.

1.6 SUBSEQUENT CHAPTERS

So far, the background to the research has been discussed. Then, research question and objectives were defined in this first chapter. A brief outline of the

following chapters is described below.

Chapter Two: Literature Review: The purpose of the literature review is to review pertinent literature and to discuss concepts related to the use of blood and blood products in the Maternity ward in hospitals in South Africa and elsewhere.

Chapter Three: Research Methodology: The chapter describes the research methodology, study design, setting and scope and data management techniques used in this study.

Chapter Four: Presentation of Results: This chapter deals with an analysis of the data collected for this study relating to its aims and objectives.

Chapter Five: Discussion: The findings from the review of the literature are incorporated in this chapter with the results obtained from the analysis in order to address the aims and objectives of the study.

Chapter Six: Conclusions and Recommendations: This constitutes the last chapter of the report and derives conclusions from the research related to the objectives of this study, makes recommendations and advocates areas for future research in the field of the transfusion of blood and blood products in the maternity ward.

CHAPTER 2
LITERATURE REVIEW

In this chapter, relevant literatures into the field of the transfusion of blood and blood products in the maternity ward are discussed. In addition to published literature, information from various unpublished sources is also reviewed.

2.1 MATERNAL HEALTH SERVICES

Millennium Development Goal number 5 stipulates that maternal mortality rate must be reduced by three-quarters (75%) between 1990 and 2015 (WHO, 2004). The countries in Sub-Saharan Africa have the biggest challenge to achieve these goals as the child and maternal death rates are highest in this region (WHO, 2005).

South Africa is one of the countries that have prioritised the lives of both mothers and children to achieve the targets of MDG 5 (Department of Health. 2007e).

Although free maternal care was introduced for all South Africans in 1995, Maternal Mortality Ratio remained significantly high (400/100 000 in 2005) for a middle-income country such as South Africa (Hill, Thomas, AbouZahr, et al. 2007; HST, 2010).

In 1998, the South African Demographic and Health Survey (SADHS) reported a Maternal Mortality Ratio (MMR) of 150 per 100 000 live births, while in 2002, Statistics South Africa (StatsSA) estimated MMR to be at 124/100 000. During the period of 2005–2007; there has been a 20.1% increase in the number of deaths. Obstetric haemorrhage (antepartum and postpartum haemorrhage; 12.4%) remained as one of the big five causes of maternal mortality in South Africa, other conditions being non-pregnancy related infections – mainly AIDS (43.7%), complications of hypertension (15.7), pregnancy-related sepsis (9.0%),

and pre-existing maternal disease (6.0%). The risk of death from obstetric haemorrhage is highest among the women 35 years and older. Complications of obstetric haemorrhage among others were responsible for 4 out of 5 of the avoidable deaths (Department of Health, 2007a; Department of Health, 2007b; Department of Health, 2007c). In view of that, the Committee on Confidential Enquiries into Maternal Deaths in South Africa suggested availability of blood and blood products for transfusion (whole blood, fresh frozen plasma, platelets and blood expander) as one of their key recommendations for improvement of maternal health services in South Africa.

Recommendations included the following; Improving health care provider knowledge and skills in providing emergency care and ensuring adequate screening and treatment of the major causes of maternal death and improving quality and coverage of reproductive health services, namely; contraceptive and termination of pregnancy services. The recommendations also included management and provision of staffing and equipment norms, transport as well as community involvement and empowerment regarding maternal, neonatal and reproductive health in general (Department of Health, 2007c).

2.2 OBSTETRIC HAEMORRHAGES

Obstetric haemorrhage is one of the leading causes of maternal mortality and morbidity (WHO, 2005). Obstetric haemorrhage accounts for 34% of maternal deaths in Africa (Khan, Wojdyla, Say, et al., 2006; Bates, Chapotera, McKew, et al., 2008). About half of the global maternal deaths from severe bleeding occurs in sub-Saharan Africa (Ronsmans and Graham, 2006; Bates et al, 2008). In a study by Gandhi et al (2004) undertaken in Kwa-zulu Natal, South Africa, it was found that haemorrhage accounts for 32% of cases of severe acute maternal morbidity. This study also took note that 57% of maternal mortality cases at a tertiary hospital in Pretoria were referred from primary care where a scarcity of blood products led to insufficient management (Gandhi, Welz, and Ronsmans,

2004). Furthermore, the National Department of Health recorded that Obstetric Haemorrhage (both antepartum and postpartum haemorrhage) accounted for 13.4% of direct causes of maternal deaths during the year 2002-2004 (Department of Health, 2007c).

Obstetric haemorrhages can be broadly classified as early pregnancy (such as ectopic pregnancy and abortion), antepartum (such as placenta preavia and placenta abruption), intrapartum and postpartum (Jansen, van Rhenen, Steegers, et al., 2005). Blood transfusions form an integral and essential part in the management of patients with obstetric haemorrhage. Timely and appropriate intervention can make the greatest difference to a possibly disastrous outcome from a patient with obstetric haemorrhage (Jansen et al, 2005).

Blood transfusions involve a number of factors including available blood products, the indications for transfusion, the process itself, as well as the complications that can arise from the transfusion.

- The majority of transfusions are required following post-partum haemorrhage and 96% of blood transfusions are performed in the postpartum period. The remaining 4% are performed antenatally (Parker, Thompson and Stanworth, 2009).
- The common antepartum indications for blood transfusion include ectopic pregnancy, abortion, disorders of placentation (including accreta, placenta previae), abruptio placenta, multiple pregnancy, oligohydramnios, polyhydramnios and previous history of abortions and antepartum haemorrhage (Nel, 1995).
- During intra-partum period, blood transfusions were found to be associated with preterm pregnancy, low birth weight of infant, short duration of labour and longer duration of ruptured membranes, caesarean section (CS), Induction of labour, assisted delivery and in breech extraction (Nel, 1995). Whereas, CS is the main trigger factor for blood transfusion during delivery (Ozumba and Ezegwui, 2006), the patients

who had induction of labour with oxytocin were 2.3 times more likely to require transfusion (Klapholz, 1990). A Nigerian study reported the rate of transfusion to be 25% among the CS patients which was related strongly to indications for C/S, preoperative anaemia and blood loss at CS. (Ozumba and Ezegwui, 2006)

It was suggested that women in the high-risk categories should be warned of the possibility of transfusion so that autologous donation can be considered especially in light of the fact that 84% of the transfused patients required 3 or less units (Klapholz, 1990).

The amount of blood and blood products used in obstetric patients varies and depends on multiple factors, such as baseline Haemoglobin (Hb), Hematocrit (Hct), Platelet, amount of blood loss, obstetric condition. A study done in the USA found that 2.6% of the patients required transfusion and the amount of transfusion varied (1U: 11.2%, 2U: 61% and 8U or more: 4%) (Klapholz, 1990).

2.3 USE OF BLOOD AND BLOOD PRODUCTS

The common blood and blood products being transfused in our maternity ward include; Red Cell components, platelets, plasma components and derivatives. Each of these products has specific indications for transfusion. For example, indication for red blood cell transfusion is the restoration of oxygen-carrying capacity. Whole blood or red cell concentrates are used to improve tissue oxygenation when this is impaired by haemorrhage or anaemia. An acute blood loss of greater than 20% of blood volume (about 1000-1200 ml of blood in an adult) will often result in the need for red cell transfusion (Department of Health, 2008).

However, in many instances correct indications are not always followed. For example, a study conducted in a rural district hospital in western Kenya between September 1990 and July 1991 revealed that 47% of paediatric transfusions were classified as inappropriate; 23% did not meet the criteria of having haemoglobin < 5.0 g/dl and 27% were transfused two or more days after having been requested. It was concluded that improved laboratory services, reduction of unnecessary transfusions, and increased recruitment of volunteer donors are critical for improving the appropriate and timely use of blood and reducing transfusion-associated HIV transmission (Ifenne, Essien, Golji, et al., 1997).

The study conducted in the maternity units of eight hospitals in three districts in Malawi revealed that Malawi Blood Transfusion Service provided 66.7% of the blood used by hospitals while the decentralised hospital-based system provided the rest of one-third. The major challenges faced by the dual system included poor communication, inadequate knowledge of the availability and clinical use of blood, difficulties recruiting and retaining donors, difficulties distributing blood, high prevalence of HIV and costs of running the two systems.

In South Africa, the use of blood and blood products is regulated and legislated by the National Health Act, 2004 (South Africa, 2004).

Although blood transfusion is a necessary and often life-saving intervention, it is also associated with a number of serious complications. Santoso, Lin, Miller, (1995) described the complications of transfusion in three categories according to aetiology: infectious, non-infectious and immunological. There is a lack of research regarding the rates of transfusion related complications in obstetric practice in South Africa.

2.4 COST OF BLOOD AND BLOOD PRODUCTS

Transfusion support is an essential component of clinical medicine, with

transfusion being life-saving in many acute situations and many chronically ill individuals receiving regular therapy (Guidelines for National Blood Transfusion Services 2006). Poor public and donor awareness, loss of staff working in blood transfusion services and the changes in the clinical demand for blood and blood products, lead to high demands for the service resulting in high costs of such blood and blood products. Activities such as; blood donor recruitment, blood collection, blood processing and blood storage and distribution together with capital and recurrent costs play a major role in determining the cost.

South African National Blood Service determines pricing scales regarding; clinical services, diagnostic state prices, blood and platelet products and pathology services prices. These prices are provided per individual product and are invoiced as per request. It is therefore possible to cost each and every unit or item ordered. They also provide tariffs for after-hours service that they have provided.

CHAPTER 3
METHODOLOGY

The methodology for this study was selected on the basis of its aims and objectives. In this chapter the following were discussed: setting, scope, and study design and research tools.

3.1 STUDY DESIGN

A cross sectional study design was used for this study. Retrospective record review was done and information was extracted from data contained in the Boitumelo Regional hospital maternity registers, laboratory registers, blood and blood products administration register for the period 01 April 2009 – 31 March 2010.

3.2 SETTING OF THE STUDY

The setting of this study is the Maternity ward at Boitumelo Regional Hospital.

Boitumelo Regional Hospital is situated in the Fezile Dabi District (previously known as the Northern Free State District) in the Free State Province. The District comprises of four sub-districts, namely; Moqhaka (wherein Boitumelo Regional Hospital is situated), Metsimaholo (wherein Metsimaholo District Hospital is situated), Ngwathe (wherein both Parys and Tokollo District Hospitals are situated) and Mafube (wherein Mafube District Hospital is situated). These four district hospitals refer their patients (including complicated maternity cases) to Boitumelo Regional Hospital.

Boitumelo Regional Hospital is the only Level 2 hospital in the district and the only hospital in the Moqhaka sub-district. As a result of that, it has to provide some Level 1 services to patients that are supposed to be managed at district

hospitals. There are two community health centres and eight primary health care clinics within Moqhaka Sub-district. These two community health centres refer all their complicated maternity cases to Boitumelo Regional Hospital. The District has a population of about 518,024 of which 441,580 (85%) is uninsured (Free State Department of Health, 2008).

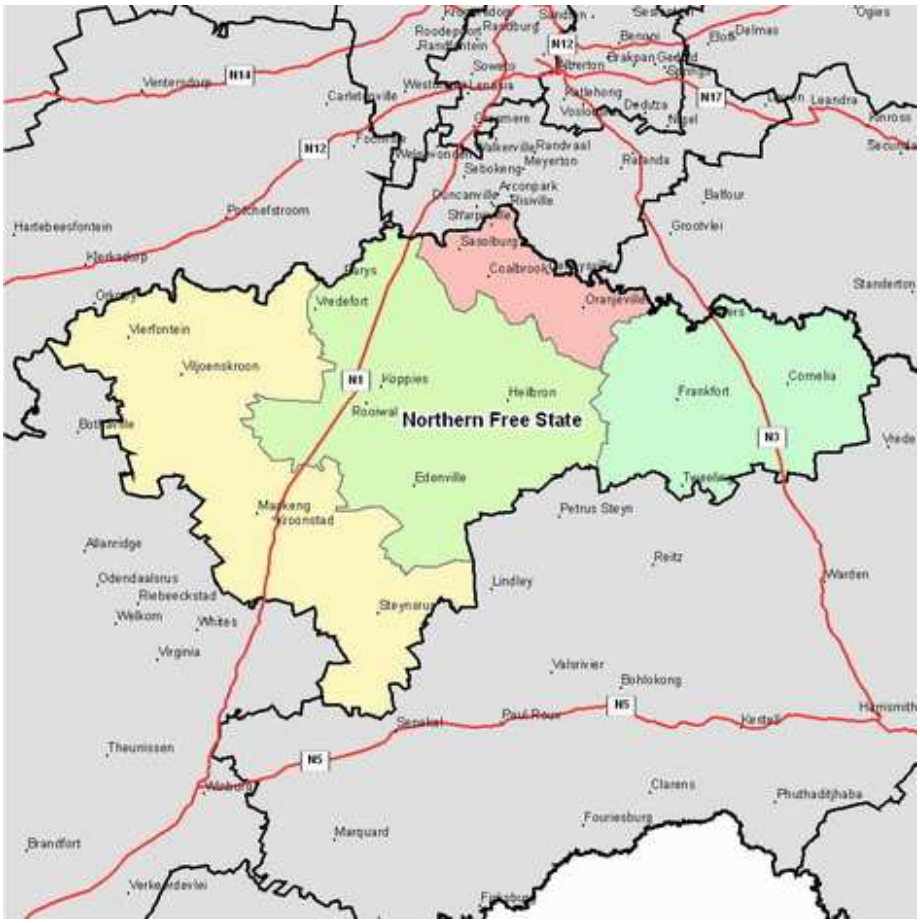

Figure 3.1 Fezile Dabi District

Although the Hospital has 345 approved beds, only 312 beds are currently used. In the Maternity unit, there are 13 antenatal beds, 7 labour (delivery) beds, 22 post natal beds and 11 lodger and kangaroo beds. Average bed occupancy rate of the Unit is approximately 95% through-out the year. The Hospital experiences between 180 – 250 normal deliveries per month and between 65 – 74 complicated deliveries per month.

3.3 SCOPE OF THE STUDY

The study involved retrospective review of patients' records who delivered at the Maternity Unit of the Boitumelo Hospital and received transfusion. No primary data was collected for the study. No intervention was done.

3.4 STUDY PERIOD

The study period was one year from 01 April 2009 to 31 March 2010.

3.5 STUDY POPULATION AND SAMPLE

The study population included the maternity patients who had received transfusion of blood and blood products at the Boitumelo Regional Hospital during the study period.

All the patients who fulfilled the above criteria were included. Therefore, no sampling was done.

3.6 VARIABLES

Data was collected on various variables as listed in Table 3.1.

Table 3.1 Relevant objectives and study variables

Objective		Variables	Type
I	Units of blood and blood product used	• Units of blood and blood product used per type	Numerical
II	Patients who received transfusion	• Number of patients received transfusion • Proportion of inpatients received transfusion	Numerical Numerical
III	Demographic profile	• Age (years) • Ethnicity • Hospital classification	Numerical Categorical Categorical
	Antepartum profile	• Parity • Gestational age(weeks) • Number of visits • Booking blood results (Hb) • Antepartum diseases • Number of Antepartum admissions	Categorical Numerical Categorical Numerical Categorical Categorical
	Intrapartum profile	• Mode of delivery • Blood loss (ml) • Blood results (Hb, Haematocrit and Platelet) on admission • Intrapartum diseases	Numerical Numerical Categorical Categorical
	Postpartum profile	• Complications (such as postpartum haemorrhage) • Time of presentation/occurrence (immediate or remote postpartum).	Categorical Categorical
	Transfusion profile	• Times prescribed, ordered and administered • Pregnancy status at time of transfusion (antepartum, intrapartum & postpartum) • Haemoglobin level (immediately pre and post transfusion) • Platelet level (immediately pre and post transfusion) • Indication(s) for transfusion • Quantity of units transfused per type • Quantity rejected • Reason(s) for rejection	Numerical Categorical Numerical Numerical Categorical Numerical Numerical Categorical
	Maternal & foetal outcome	• Discharged, transferred, died	Categorical

3.7 DATA COLLECTION

Permission to conduct the study was sought from the Chief Executive Officer of the Hospital. Data for this study was routinely collected on monthly basis as part of Hospital Information System. Data from various sources within the Maternity ward was exported to MS Excel and then extracted to MS Excel based data collection tools designed for this study (Annexure A). Study numbers were allocated to each patient to maintain confidentiality.

3.8 DATA ANALYSIS

Extracted data was analysed with NCSS (NCSS, 2007). Descriptive data analysis was used such as central tendency (mean and median) and spread (standard deviation and interquartile range) for numerical variables. Categorical variables (such as ethnicity) were presented as proportions. Analytical statistics (such as t-test or Mann-Whitney's U test (if data is not normally distributed) for numerical variables and chi-square test for categorical variables) was used to compare between two groups (such as Hb level before and after transfusion).

3.9 ETHICAL CONSIDERATIONS

Information was collected anonymously from the patients' records, maternity registers and blood bank records; using the data tool developed for each objective. No patient names or hospital numbers was used; rather study numbers were allocated to different patients. Raw data from where the information was extracted was only available to the researcher. Permission to conduct the research at Boitumelo Regional Hospital was sought from the Chief Executive Officer of the Hospital. The researcher also received approval from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand.

CHAPTER 4
RESULTS

The results obtained from the analysis of data were described in this chapter.

4.1 NUMBER OF DELIVERIES

The number of deliveries during the study period is listed in the Table 4.1. The majority of patients had normal delivery (1474, 64%). Thirty-four percent (n=776) women had caesarean section and 2% (n=54) had assisted vaginal delivery.

Table 4.1 Number of deliveries

	Total deliveries	NVD	CS	Assisted deliveries
April 2009	200	138	57	5
May 2009	177	118	59	0
June 2009	225	145	67	13
July 2009	193	131	57	5
August 2009	192	118	70	4
September 2009	199	131	59	9
October 2009	167	109	56	2
November 2009	174	99	72	3
December 2009	205	138	65	2
January 2010	175	100	72	3
February 2010	162	104	57	1
March 2010	235	143	85	7
Total	**2304**	**1474**	**776**	**54**

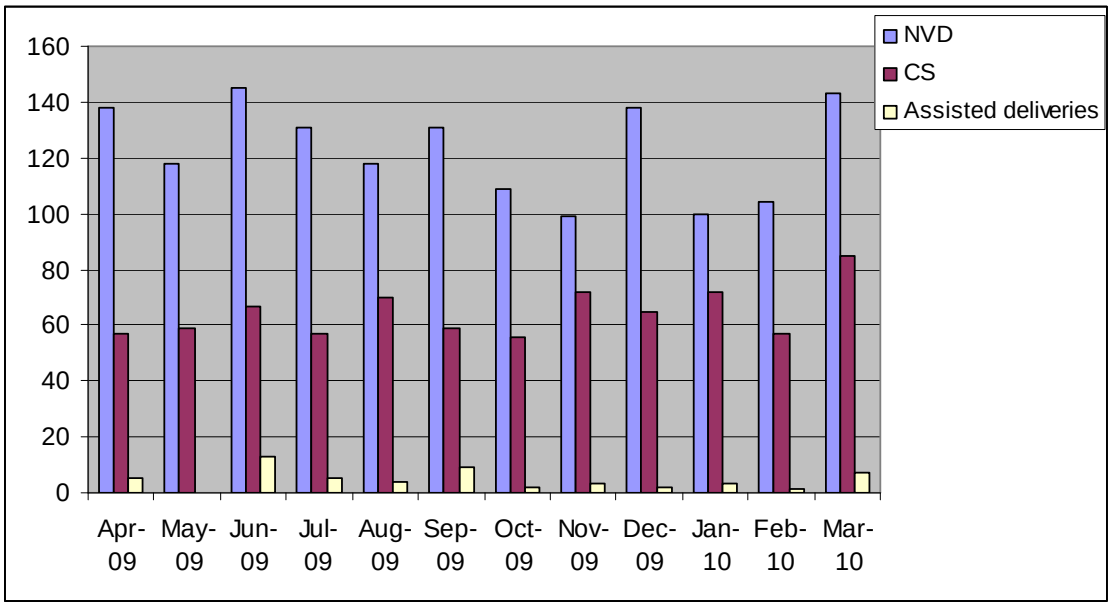

Figure 4.1 Number of deliveries

4.2 NUMBER OF PATIENTS WHO RECEIVED TRANSFUSION

The number of deliveries during the study period is listed in the Table 4.2. Ninety-nine (4.2%) among these 2304 patients received blood and blood products transfusion.

Table 4.2 Number of patients receiving transfusion

	Total deliveries	No received transfusion
April 2009	200	13 (14%)
May 2009	177	8 (8%)
June 2009	225	5 (5%)
July 2009	193	8 (8%)
August 2009	192	12 (12%)
September 2009	199	11 (11%)
October 2009	167	9 (9%)
November 2009	174	6 (6%)
December 2009	205	5 (5%)
January 2010	175	5 (5%)
February 2010	162	10 (10%)
March 2010	235	7 (7%)
Total	**2304**	**99 (4.2%)**

The following sections will describe the profiles of patients who received transfusion.

4.3 SOCIO-DEMOGRAPHIC PROFILE

4.3.1 AGE

The mean age of the subjects was 26 years (± 6.7 years). The minimum and maximum ages were 16 and 42 years.

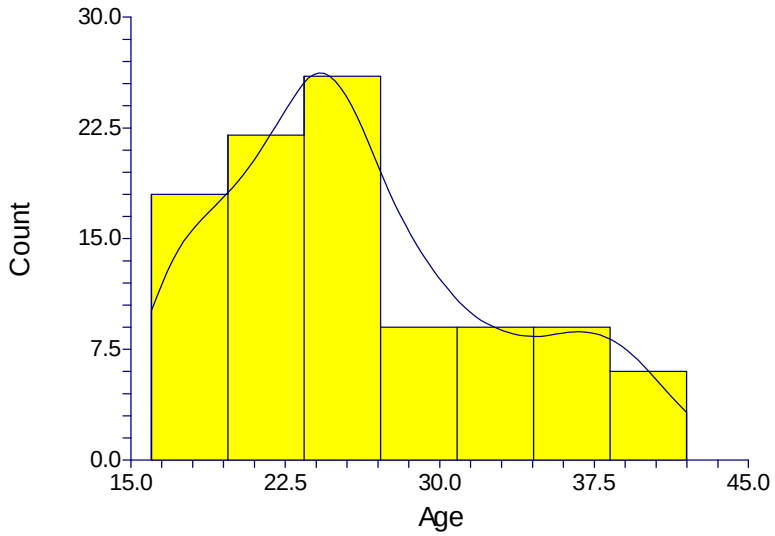

Figure 4.1 Age distribution

4.3.2 ETHNICITY

The ethnicity of the subjects is described in Table 4.3

Table 4.3 Ethnicity of the subjects

Ethnicity	Count (%)
Coloured	1 (1.01%)
Sotho	59 (59.6%)
Xhosa	25 (25.25%)
Zulu	14 (14.14%)
Total	99 (100%)

4.3.3 HOSPITAL CLASSIFICATION

All patients were classified as non-paying (H0) patient.

4.4 OBSTETRIC PROFILE

4.4.1 PARITY

The parity of the subject is described in Table 4.4. The median parity was 1 (Inter-quartile range was 0 to 2).

Table 4.4 Parity

Parity	Count	Percentage
0	32	32.65
1	28	28.57
2	23	23.47
3	10	10.2
4	4	4.08
5	1	1.02
Total	99	100

4.4.2 GESTATIONAL AGE AT THE TIME OF DELIVERY

The mean age was 35 weeks (± 4.1 years). The minimum and maximum gestational ages were 23 and 40 (Figure 4.2).

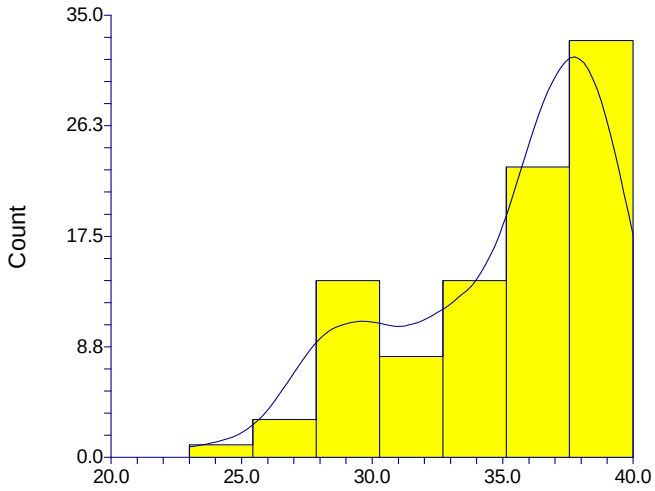

Figure 4.2 Gestational age at the time of delivery

4.4.3 NUMBER OF ANC VISITS

The median number of ANC visits was 2 (Inter-quartile range was 1 to 4) (Figure 4.3).

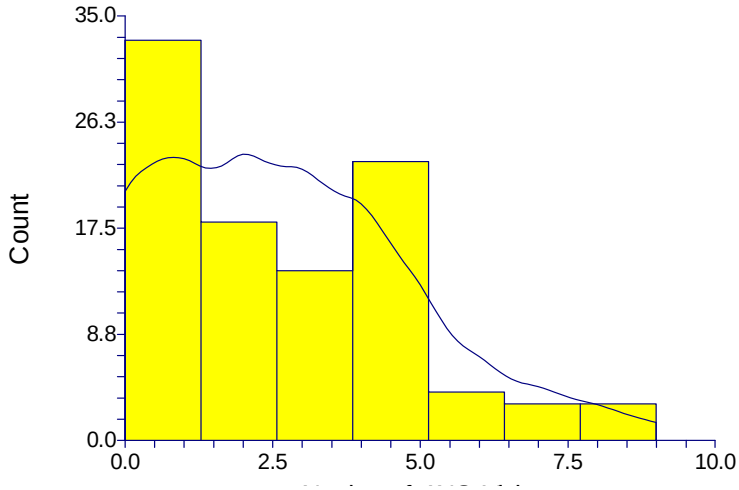

Figure 4.3 Number of ANC visits

4.4.4 BOOKING BLOOD RESULTS

The mean haemoglobin at the time of booking was 10.6 g/dl (± 1.7 g/dl) with minimum and maximum levels were 6.7 and 14 g/ dl (Figure 4.4). Thirty-six (36%) of them had anaemia according to booking blood result (Hb < 11 g/ dl).

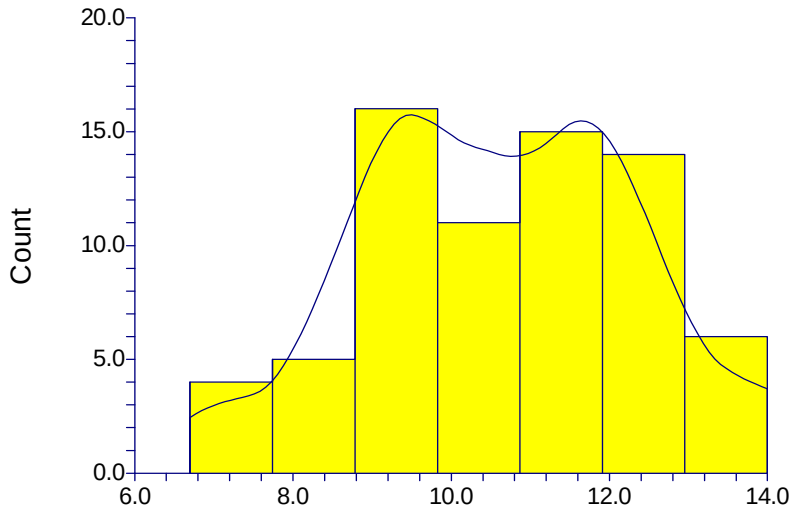

Figure 4.4 Booking Hb (g/dl)

4.4.5 DISEASES DURING ANTENATAL PERIOD

Fourty-three (43%) subjects had some diseases during antenatal period (Table 4.5). Some patients had more than one disease. Pregnancy Induced hypertension was commonest (27.3%), followed by HIV (15.2%). Anaemia was detected in only 10 (10.1%) of subjects, although 36% (36%) of them had anaemia according to booking blood result (Hb < 11 g/ dl).

Table 4.5 Diseases during antenatal period

Diseases	Count	Percentage
Anaemia	10	10.1%
CCF	1	1.0%
Pregnancy Induced Hypertension	27	27.3%
Asthma	1	1.0%
HIV	15	15.2%

Six of them required admission during ante-natal period. Two of the patients with Pregnancy Induced Hypertension developed HELLP Syndrome.

Obstetrics problems found during the antenatal period were listed in Table 4.6.

Table 4.6 Obstetric diseases during antenatal period

Diseases	Count	Percentage
Antepartum Haemorrhage (APH)	18	18.4%
Pre-term labour	49	49.5%
Oligohydramnios	1	1.0%

4.4.6 MODE OF DELIVERY

The mode of delivery of the subject was described in Table 4.7. The percentage of NVD is slightly lower than the entire cohort of patients who delivered at the hospital during this period.

Table 4.7 Mode of delivery

Mode of delivery	Count	Percentage
Normal Vaginal Delivery	59	59.6%
Born Before Arrival	1	1.0%
Breech	2	2.0%
Caesarean Section	36	36.4%
Twin	1	1.0%
Total	99	100.0%

4.4.7 TOTAL BLOOD LOSS

The total blood loss during this period is described in Figure 4.5. The median blood loss was 400 ml (Inter-quartile range was 300 ml to 500 ml). The minimum and maximum blood losses were 100 ml and 1500 ml respectively. Among the patient who had vaginal delivery (n=63), 17 (27%) had blood loss more than 500 ml. Among the patient who had CS (n=36), one (3%) subject had a blood loss more than 1000ml.

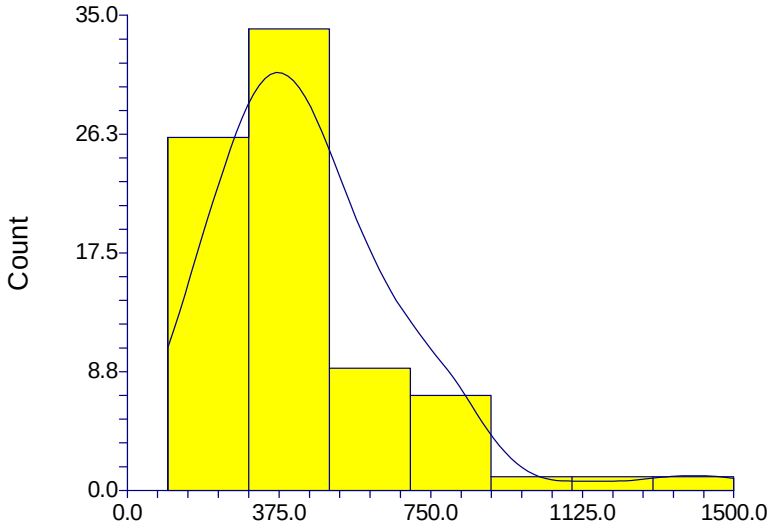

Figure 4.5 Total blood loss (ml)

4.4.8 BLOOD RESULTS

The pre-transfusion Hb result is described in Figure 4.6. The median Hb was 6.9 g/dl (Interquartile range 6.1 g/dl to 7.6 g/dl). The minimum and maximum Hb were 1.9 g/dl and 9.9 g/dl respectively. All of them had a Hb less than 11 g/ dl.

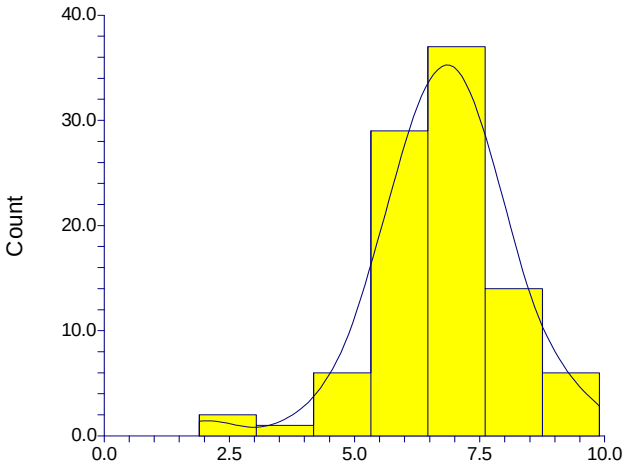

Figure 4.6 Pre-transfusion Hb (g/dl)

The pre-transfusion Hct result is described in Figure 4.7. The median Hct was 0.23 (Interquartile range 0.18 to 0.26). The minimum and maximum Hct were 0.1 and 0.35 respectively.

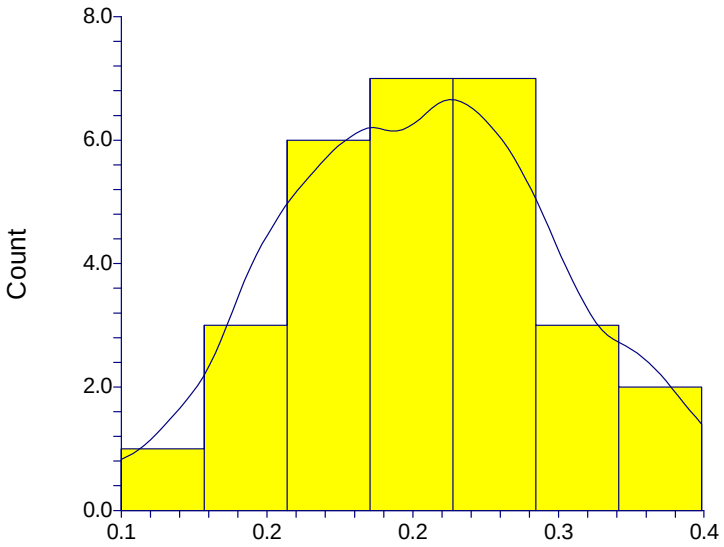

Figure 4.7 Pre-transfusion Hct

The pre-transfusion platelet result is described in Figure 4.8. The median platelet level was 242,000/µl (Interquartile range 154,000/ µl to 313,000/ µl). The minimum and maximum platelet levels were 45,000/ µl and 507,000/ µl respectively.

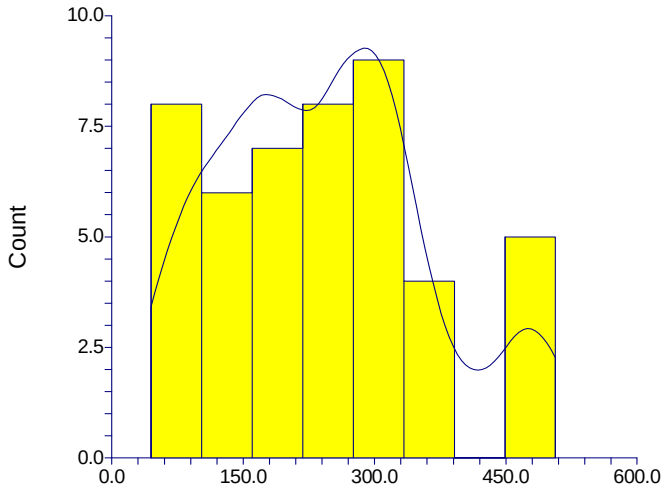

Figure 4.8 Pre-transfusion Platelet level (in 000/ µl)

4.5 TRANSFUSION

4.5.1 INDICATIONS FOR TRANSFUSION

Seventeen (17.5%) patients were transfused before delivery and one (1%) was transfused during delivery and 81 patients (81.5%) were transfused after delivery.

Eighteen of them (18.4%) were transfused for APH and 81 (81.6%) of them were transfused for PPH.

4.5.2 BLOOD RESULTS BEFORE AND AFTER TRANSFUSION

The median Hb level after transfusion was 9.8 g/ dl (Inter-quartile range 8.9 g/ dl to 10.5 g/ dl). The minimum and maximum Hb levels were 7.3 g / dl and 13.4 g/ dl respectively. There was a significant increase in Hb level between before and after transfusion (Mann-Whitney's U test, $p < 0.0001$).

The median Hct level after transfusion was 0.31 (Inter-quartile range 0.23 to 0.32). The minimum and maximum Hct levels were 0.15 and 0.37 respectively. There was a significant increase in Hct level between before and after transfusion (Mann-Whitney's U test, $p < 0.01$).

The median platelet level after transfusion was 211,000/ µl (Inter-quartile range 144,000/ µl to 308,00/ µl). The minimum and maximum platelet levels were 59,000/ µl and 359,000/ µl respectively. There was no significant increase in platelet level between before and after transfusion (Mann-Whitney's U test, $p = 0.1$).

4.5.3 TRANSFUSION PRODUCTS

There were four types of transfusion products used: Whole Blood, Red Blood Cells, Fresh Frozen Plasma and Platelets. The number of units used for each type of products is listed in Table 4.8.

Table 4.8 Transfusion products

	Number of patients	Total units	Average per patient
Whole Blood	3	13	4.3
Red Blood Cells	99	250	2.5
Fresh Frozen Plasma	11	33	3
Platelets	1	1	1

Monthly uses of these products are shown in Figure 4.9. There are some variations in monthly uses, but they are not statistically significant (p=0.1).

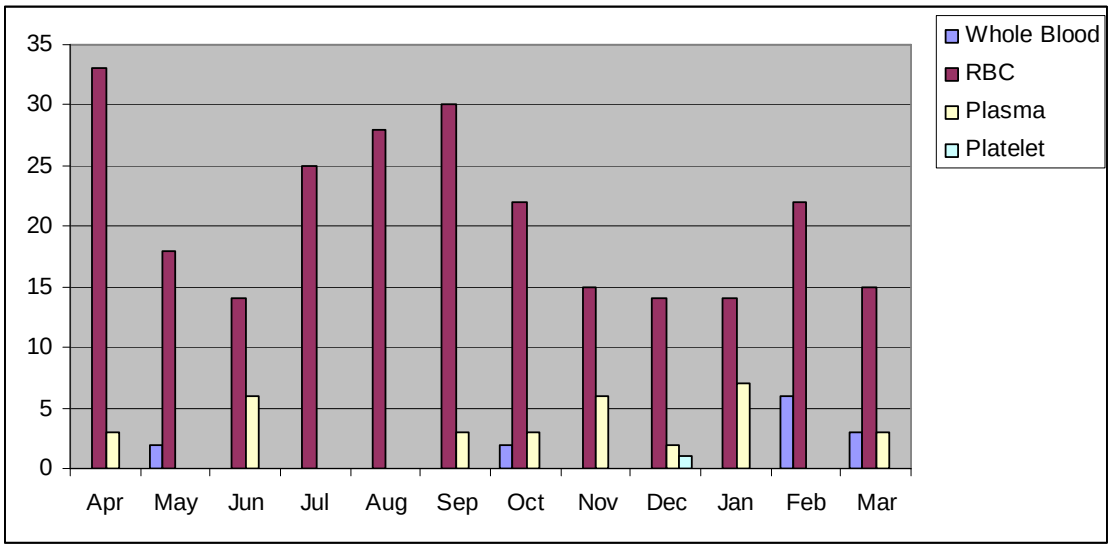

Figure 4.9 Monthly uses of transfusion products

4.5.4 REJECTION OF TRANSFUSION UNITS

All patients who were legible to receive blood and or blood products received their units. None of the units were rejected.

4.5.5 TURN-AROUND TIME

The turn-around times for transfusion products are listed in Table 4.9. The median time interval between prescription and ordering blood was 30 min, whereas median time interval between order and receipt was 50 min and median time interval between receipt and administration was 60 min. The median time interval between prescription and administration was 160 min which is quite long, in an emergency situation like antepartum or post-partum haemorrhage.

Table 4.9 Turn-around time

	Time between prescribed and ordered	Time between ordered and received	Time between received and administered	Total time between prescribed and administered
Median	30 min	50 min	60 min	160 min
Inter-quartile range	15 min to 70 min	30 min to 80 min	45 min to 65 min	115 min to 225 min
Minimum	0 min	0 min	10 min	0 min
Maximum	240 min	420 min	680 min	720 min

4.6 COST OF TRANSFUSION

The number of units used for four types of product (Namely whole blood, Red Blood Cells, Fresh Frozen Plasma and Platelet), their unit costs and total cost per month are listed in the Table 4.10. Thirteen (13) units of whole blood were transfused; two hundred and fifty (250) units of red blood cells were transfused and thirty three (33) units of fresh frozen plasma units were transfused while only one (1) unit of platelet was transfused.

Table 4.10 Cost of transfusion

Month	Unit Cost				Number used				Total Cost			
	Whole Blood	RBC	Plasma	Platelet	Whole Blood	RBC	Plasma	Platelet	Whole Blood	RBC	Plasma	Platelet
April 2009	R353.97	R1128.77	R903.01	R6542.03	0	33	3	0	R353.97	R37249.41	R2709.03	0
May 2009	R353.97	R1128.77	R903.01	R6542.03	2	18	0	0	R707.94	R20317.86	R903.01	0
June 2009	R353.97	R1128.77	R903.01	R6542.03	0	14	6	0	R353.97	R15802.78	R5418.06	0
July 2009	R353.97	R1128.77	R903.01	R6542.03	0	25	0	0	R353.97	R28219.25	R903.01	0
August 2009	R353.97	R1128.77	R903.01	R6542.03	0	28	0	0	R353.97	R31605.56	R903.01	0
Sept. 2009	R353.97	R1128.77	R903.01	R6542.03	0	30	3	0	R353.97	R33863.10	R2709.03	0
Oct. 2009	R353.97	R1128.77	R903.01	R6542.03	**2**	22	3	0	R707.94	R24832.94	R2709.03	0
Nov. 2009	R353.97	R1128.77	R903.01	R6542.03	0	15	6	0	R353.97	R16931.55	R5418.06	0
Dec. 2009	R353.97	R1128.77	R903.01	R6542.03	0	14	2	1	R353.97	R15802.78	R1806.02	R6542.03
Jan. 2010	R353.97	R1128.77	R903.01	R6542.03	0	14	7	0	R353.97	R15802.78	R6321.07	0
Feb. 2010	R353.97	R1128.77	R903.01	R6542.03	6	22	0	0	R2123.82	R24832.94	R903.01	0
Mar. 2010	R353.97	R1128.77	R903.01	R6542.03	3	15	3	0	R1061.91	R16931.55	R2709.03	0
Total					13	250	33	1	R 7,433.37	R 282,192.50	R 33,411.37	R 6,542.03

Whole blood units transfused for the research period cost the Hospital R7 433.37, Red Blood Cell R282 192.50, Fresh Frozen Plasma R33 411.37 while it cost the hospital R6 542.03 for the platelet transfusion (Figure 4.10). Patients requiring platelet transfusion are normally transferred to the tertiary hospital

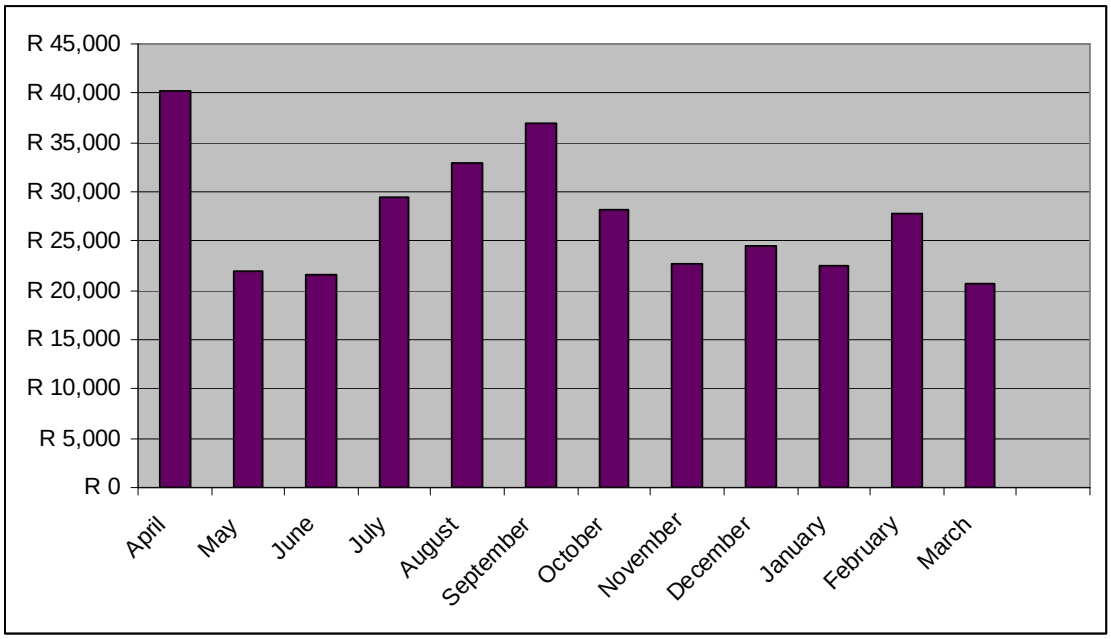

Figure 4.10 Monthly cost of transfusion

The total cost of transfusion during one year study period was R 329,579.27.

CHAPTER 5
DISCUSSION

In this chapter, the results obtained from the analysis of the data were discussed and compared with those from other published studies.

5.1 INTRODUCTION

This study was done in order to describe the use of blood and blood products in the Maternity ward of the Boitumelo Regional Hospital, the factors associated with these specified blood and blood products during one study period (1 April 2009 to 31 March 2010). No study had been conducted at the level of a regional hospital in the Free State Province to look at the influence of various factors on the use of blood and blood products.

Among the patients who delivered at the Boitumelo Regional Hospital (n=2304), 99 (4.2 %) patients received blood and blood products transfusion, which was similar to the finding of the study done at the Charlotte Maxeke Johannesburg Academic Hospital (5%) (Basu, et al., 2012); however higher than a study done in the USA found 2.6% of the obstetrics patients required blood transfusion.

5.2 PROFILE OF PATIENTS

The mean age of the subjects was 26 years (± 6.7 years). The majority of them were Sotho speaking (n=59, 59.6%), followed by Xhosa speaking 25 (25.2%). All patients were classified as non-paying (H0) patient, which implies that Hospital had to pay the entire cost incurred for blood transfusion.

The median parity was 1. Almost third of them (32, 32.6%) were primipara. The mean gestational age was 35 weeks (± 4.1 years). The minimum and maximum gestational ages were 23 and 40. Fourty-nine (49.5%) of them had gestational

age less than 37 weeks, signifying a possible link between pre-term labour and need for blood transfusion. The median number of ANC visits was 2 (Inter-quartile range was 1 to 4). Twenty (20.4%) of them never attended any antenatal clinic.

The mean haemoglobin level at the time of booking was 10.6 g/dl (± 1.7 g/dl). Anaemia was diagnosed in only 10 (10.1%) of subjects, although 36 (36.4%) of them had anaemia according to booking blood result (Hb < 11 g/ dl). One of the anaemic patient subsequently developed Congestive Cardiac Failure. This signifies poor antenatal management of anaemia and failure to detect anaemia based on booking blood results and to provide iron and folic acid which could have avoided the need for blood transfusion. Among the other antenatal diseases, Pregnancy Induced hypertension was commonest (27.3%) followed by HIV (15.2%).

Unlike other studies (Klapholz, 1990; Nel, 1995), the majority of the subjects who received transfusion, (59, 59.6%) had NVD, which was similar to the findings of the South African study which reported 61% had NVD (Basu, et al., 2012). Only 5% (36/776) CS patients received transfusion, which is much lower than the figure (25%) reported in the Nigerian study (Ozumba and Ezegwui, 2006).

The median blood loss was 400 ml (Inter-quartile range was 300 ml to 500 ml). The minimum and maximum blood losses were 100 ml and 1500 ml respectively. Among the patients who had vaginal delivery (n=63), 17 (27%) had blood loss more than 500 ml. Among the patients who had C/S (n=36), one (3%) subject had a blood loss more than 1000ml

5.3 TRANSFUSION

Thirteen (13) units of whole blood were transfused; 250 units of red blood cells were transfused and 33 units of fresh frozen plasma units were transfused while

only (1) one unit of platelet was transfused.

Eighteen (18.4%) patients were transfused during antepartum and intrapartum period and 81 (81.6%) of them were transfused during postpartum period unlike the study done by Parker, et al (2009) and Basu et al (2012), which reported 96% of the transfusion was done during postpartum period.

The median pre-transfusion Hb was 6.9 g/dl which is lower than the Hb level 7.6 g/dl reported by Basu et al (2012). The median pre-transfusion Hct and platelet were 0.23 and 242,000/ µl respectively. As expected the post-transfusion Hb and Hct improved significantly after transfusion.

All the patients received Red Blood Cells (99, 100%), which was similar to the findings of the study done in Johannesburg (Basu, et al, 2012). Few patients received whole blood (3%), Fresh Frozen Plasma (11.1%) and Platelets (1%). Average unit of Red blood cells transfused per patient was 2.5, which is slightly higher than Klapholz (1990) and Basu et al (2012) (2U/ per patient). There are some variations in monthly uses of these products, but they are not statistically significant (p=0.1).

All patients who were legible to receive blood and or blood products received their units. None of the units were rejected, which signifies good use of these precious products.

The turn-around times for transfusion products are of concern. As no study had reported this before, it is difficult to benchmark the findings of this study. However, the median time interval between prescription and ordering blood was 30 min, whereas median time interval between order and receipt was 50 min and median time interval between receipt and administration was 60 min. The median time interval between prescription and administration was 160 min which is quite long, in an emergency situation like antepartum or post-partum haemorrhage.

5.4 COST OF TRANSFUSION

The cost of Whole blood was R7, 433.37, Red Blood Cell R282, 192.50, Fresh Frozen Plasma R33, 411.37 and Platelet R6, 542.03. The total cost of transfusion during one year study period was R 329,579.27. The average cost of transfusion per patient was R3329.01.

CHAPTER 6
CONCLUSION AND DISCUSSION

In this chapter, the results obtained from this study were assessed in relation to the aims and objectives of the study, so that appropriate conclusions can be drawn. The limitations of the study are listed. Based on the findings of the study, appropriate recommendations and suggestions for future research are included.

6.1 CONCLUSIONS RELATED TO THE AIMS OF THE STUDY

This was a cross-sectional study that looked at broad issues pertaining to the use of blood and blood products in the Maternity ward of the Boitumelo Regional Hospital, and the factors associated with these specified blood and blood products during one study period

6.1.1 DESCRIPTION OF THE SPECIFIED BLOOD AND BLOOD PRODUCTS ORDERED IN THIS WARD DURING THE STUDY PERIOD

During the one year study period, 13 units of whole blood were transfused; 250 units of red blood cells were transfused and 33 units of fresh frozen plasma units were transfused while only 1 unit of platelet was transfused.

6.1.2 DETERMINATION OF THE NUMBER OF PATIENTS WHO RECEIVED TRANSFUSION DURING THE STUDY PERIOD

Ninety-nine (4.2%) among these 2304 patients delivered during this one year period received blood and blood products transfusion.

6.1.3 DETERMINATION OF THE FACTORS ASSOCIATED WITH UTILIZATION OF THESE PRODUCTS IN THE MATERNITY WARD DURING THE STUDY PERIOD

Primiparity (32, 32.6%), pre-term labour (49, 49.5%), booking status (unbooked 20, 20.4%) were found to be common among these patients. A significant number of them (36, 36.4%) were anaemic based on their booking Hb but only a few of them were diagnosed and treated for anaemia. Among the other antenatal diseases, Pregnancy Induced hypertension was commonest (27.3%) followed by HIV (15.2%).

The majority of the subjects who received transfusion, (59, 59.6%) had NVD. Only 5% (36/776) CS patients received transfusion, which is much lower than other studies. The median blood loss during delivery was 400 ml.

Seventeen (17.5%) patients were transfused before delivery and one (1%) was transfused during delivery and 81 patients (81.5%) were transfused after delivery. Eighteen of them (18.4%) were transfused for APH and 81 (81.6%) of them were transfused for PPH.

6.1.4 DETERMINATION OF THE TURN-AROUND TIME OF THESE PRODUCTS

The median time interval between prescription and administration was 160 min which is quite long, and are of concern. Although the time interval between order and receipt (median 50 min) could be necessary for cross-match, the other two components (a) interval between prescription and ordering blood (median 30 min) and (b) time interval between receipt and administration (median 60 min) could easily be reduced.

6.1.5 DETERMINATION OF THE COST OF THESE PRODUCTS USED DURING THE STUDY PERIOD

The total cost of transfusion during one year study period was R 329,579.27 (Whole blood: R7, 433.37, Red Blood Cell: R282, 192.50, Fresh Frozen Plasma: R33, 411.37 and Platelet: R6, 542.03). The average cost of transfusion per patient was R3329.01. As no study had reported this before, it is difficult to benchmark the findings of this study.

6.2 LIMITATIONS OF THE STUDY

The major limitations were the following;

- Completeness of the electronic records. Some of the records were not completed, where some information was missing. The researcher retrieved the files of the patients and entered them manually
- Retrospective record review is a limitation in itself as no further clarity or follow up could be made as no primary data could be collected. In addition, no causal link could be established.

6.3 RECOMMENDATIONS

6.3.1 FOLLOW-UP

This project is the first systematic study to be done at the Boitumelo Regional Hospital. This study identified the areas where management of patients could be improved such as early detection of anaemia based on booking Hb and provision of treatment to these patients. In addition, significantly a significant number of patients who were transfused delivered normally. There might be a need to have active management of third stage to prevent PPH.

The results of the study will be disseminated to the Chief Executive Officer for the Hospital, Chief Director for the district and Executive Manager: Clinical Health Services.

6.3.2 FUTURE RESEARCH

Based on findings of this study, the researcher would like to suggest following future studies:

(a) A prospective study to study all the patients who receive transfusion (including medical and surgical wards) at all the regional hospitals in the Free State Province to compare the use of blood and blood products in these institutions

(b) A follow-up study to evaluate the impact of transfusion on the patients who receive transfusions.

6.4 SUMMARY AND CONCLUSIONS

This is probably the first study done at a regional hospital setting in South Africa which looked at broad issues pertaining to the use of blood and blood products in the Maternity ward of the Boitumelo Regional Hospital, and the factors associated with these specified blood and blood products during one study period. The study found 99 (4.2%) among these 2304 patients delivered during this one year period received blood and blood products transfusion (13 units of whole blood, 250 units of red blood cells, 33 units of fresh frozen plasma and 1 unit of platelet). Primiparity, pre-term labour, booking status, was found to be common among these patients. A significant number of them (36, 36.4%) were anaemic based on their booking Hb but only a few of them were diagnosed and treated for anaemia. The majority of the subjects who received transfusion had NVD signifies the need for active management of third stage. The median blood loss during delivery was 400 ml. The majority of them were transfused during

postpartum period for PPH. The median time interval between prescription and administration was 160 min which is quite long and could be improved by reducing the interval between prescription and ordering blood and interval between receipt and administration. The total cost of transfusion during one year study period was R 329,579.27 and the average cost of transfusion per patient was R3329.01. The findings of this study will be reported to the Hospital management for improving management of obstetrics patients. The researcher also proposed further study among all the patients who received transfusion at all the regional hospitals in the Free State Province to compare the use of blood and blood products in these institutions.

REFERENCES

Barker CE, Bird CE, Pradhan A, et al. 2007. Support to the Safe Motherhood Programme in Nepal: An Integrated Approach. Reproductive Matters. 15(30): 81-90.

Basu JK, Hartford L, Noziphiwo N, et al. 2012. The use of blood transfusion in Obstetrics. S Afr J Epi Inf Dis (in press).

Bates I, Chapotera GK, McKew S, et al. 2008. Maternal mortality in Sub - Saharan Africa: The contribution of ineffective blood transfusion services. Br J Obstet Gynaecol, 115(11): 1331-1339.

Beksinska M, Kunene B, and Mullick S. 2006. Maternal Care. Antenatal, Peri and Postnatal. In: Ijumba P, Padarath A, editors. South African Health Review 2006. Durban: Health Systems Trust. <http://www.hst.org.za/generic/29> [accessed 07/05/2010]

Brace V, Kernaghan D, Penney G. 2007. Learning from adverse clinical outcomes: major obstetric haemorrhage in Scotland, 2003-05. BJOG. 114(11): 1388-1395.

Department of Health. 1999. Clinical Guidelines for the use of Blood and Blood products in South Africa. 2nd edition. Pretoria. Department of Health.

Department of Health. 2003. Clinical Guidelines for the use of Blood Products in South Africa (2003). 3rd edition. Pretoria: Department of Health.

Department of Health. 2007a. Guidelines for Maternity Care in South Africa (2007). A manual for clinics, community health centres and district hospitals. 3rd edition. Pretoria: Department of Health.

Department of Health. 2007b. Saving Mothers. Essential Steps in the Management of Common Conditions Associated with Maternal Mortality. Pretoria: Department of Health.

Department of Health. 2007c. Saving Mothers. Fourth Report on Confidential Enquiries into Maternal Deaths in South Africa 2005-2007. Pretoria: Department of Health.

Department of Health. 2007d. State of the World's Mothers: Saving the Lives of Children Under 5. Pretoria: Department of Health.

Department of Health. 2007e. Strategic Plan 2009/10 – 2011/12. Pretoria: Department of Health.

Department of Health. 2008. Clinical Guidelines for the use of Blood Products in South Africa. 4th edition. Pretoria: Department of Health.

Free State Department of Health, 2008. Fezile Dabi District Health Plan. Bloemfontein: Free State Department of Health.

Gandhi M, Welz T and Ronsmans C. 2004. Severe Acute Maternal Morbidity in rural South Africa. Int J Gynaecol Obstet, 87: 180-187.

Hill K, Thomas K, AbouZahr C, et al. 2007. Estimates of maternal mortality worldwide between 1990 and 2005: an assessment of available data. Lancet 370: 1311-19.

HST. 2010. Health Statistics. << http://www.hst.org.za> [accessed 07/05/2010]

Jansen A, van Rhenen D, Steegers E, et al. 2005. Postpartum Hemorrhage and Transfusion of Blood and Blood Components. Obstet and Gynecol Surv, 60(10): 663-671.

Khan KS, Wojdyla D, Say L, et al. 2006. WHO analysis of causes of maternal death: a systematic review. Lancet 367**:**1066–1074*.*

Klapholz H. 1990. Blood Transfusion in Contemporary Obstetric Practice. Obstet & Gynecol 75: 940-943.

Knight M, Callaghan WM, Berg C, et al. 2009. Trends in postpartum haemorrhage in high resource countries: a review and recommendations from the International Postpartum Haemorrhage Collaborative Group. BMC Pregnancy and Childbirth, 9**:**55 < http://www.biomedcentral.com/1471-2393/9/55> [accessed 07/05/2010]

Kongnyuy EJ and van Den Broek N. 2008. Availability of blood for transfusion in maternity units in Malawi. The Internet Journal of Third World Medicine 7(1). http://www.ispub.com/journal/the_internet_journal_of_third_world_medicine/volume_7_number_1_17/article/availability_of_blood_for_transfusion_in_maternity_units_in_malawi.html [accessed 07/05/2010]

Lackritz EM, Ruebush TK 2nd , Zucker JR, et al. 1993. Blood transfusion practices and blood-banking services in a Kenyan hospital. AIDS. 7(7):995-999.

Marchant S, Alexander J, Thomas P, et al. 2006. Risk factors for hospital admission related to excessive and/or prolonged postpartum vaginal blood loss after the first 24h following birth. Paediatr Perinat Epidemiol. 20(5): 392-402.

Mhlanga RE. 2008. Maternal, Newborn and Child Health: 30 Years On. In: Barron, P., Roma-Reardon, J., editors. South African Health Review 2006. Durban: Health Systems Trust. http://www.hst.org.za/publications/841 [accessed 07/05/2010]

Miller S, Hamza S, Bray EB, et al. 2006. First aid for obstetric haemorrhage: the pilot study of the non-pneumatic anti-shock garment in Egypt. BJOG, 113(4):424-429.

NCSS. 2007. NCSS statistical analysis and graphics. http://www.ncss.com/ncss.html [Accessed 20/12/2011]

Nel, JT. 1995. Core Obstetrics and Gynaecology Hainemann publishers, pp 835-836

Ozumba, BC and Ezegwui HU. 2006. Blood transfusion and Caesarean section in a developing country. J Obstet Gynaecol ;26(8):746-748.

Parker J, Thompson J, and Stanworth S. 2009. A retrospective one-year single-centre survey of obstetric red cell transfusions. Int J Obstet Anes, 18, 309-313.

Ronsmans C and Graham WJ. 2006. Maternal mortality: who, when, where, and why. Lancet, 368(9542): 1189: 1200.

Santoso J, Lin DW, and Miller DS. 1995. Transfusion Medicine in Obstetrics and Gynecology. Obstet Gynecol Surv, 50(6): 470- 481.

South Africa. 2003. National Health Act, no. 61, 2003. Pretoria: Government Printers.

van Den Broek N. 2007. Life Saving Skills Manual: Essential Obstetric and Newborn Care. London: Royal College of Obstetricians and Gynaecologists.

Vachhani M and Virkud A. 2007. Prophylactic B-Lynch Suture During Emergency Caesarean Section In Women At High Risk of Uterine Atony: A Pilot Study. *The Internet Journal of Gynaecology and Obstetrics.* 7(1). <http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ijgo/vol7n1/blynch.xml> [accessed 07/05/2010]

WHO. 1998. Costing Blood Transfusion Services. Geneva: World Health Organization. <http://www.who.int/bloodsafety/transfusion_services/en/Costing_BTS_Eng.pdf> [accessed 07/05/2010]

WHO. 2003. Clinical Use of Blood. Report of a Sub-Regional Workshop Yangon, Myanmar, 8-11 April 2003. Geneva: World Health Organization. < http://203.90.70.117/PDS_DOCS/B3413.pdf> [accessed 07/05/2010]

WHO. 2004. Health in the Millennium Development goals. http://www.who.int/mdg [accessed 07/05/2010]

WHO. 2005. The World Health Report 2005 - make every mother and child count. Geneva: WHO.

WHO. 2006. Maintaining a Safe and Adequate Blood Supply in the Event of Pandemic Influenza. Guidelines for National Blood Transfusion Services. Geneva: WHO. <http://www.who.int/bloodsafety/publications/WHO_Guidelines_on_Pandemic_Influenza_and_Blood_Supply.pdf> [accessed 07/05/2010]

APPENDICES

APPENDIX A: ETHICS CLEARANCE CERTIFICATE AND LETTERS OF APPROVAL

APPENDIX B: DATA COLLECTION INSTRUMENTS